Project: **1398**
Project title: **OceanWeather**
Principal investigator: **Wolfgang Mueller**
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Maximum of 2 pages including figures. 9 pt minimum font size.

Report

Technical Setup

Julian Krüger's work as part of the Ocean Weather project began on April 1, 2024. Within the last 7 months progress has been made in developing the coupled ICON-XPP model configuration in the frame of the ICON-Seamless initiative using a high-resolved ocean component (R2B8, ~10km) and a 40km atmosphere component (R2B6).

The first steps involved establishing the technical setup. Two coupled ICON-XPP experiments were carried out over short periods of time. First, a preindustrial control run with an atmospheric resolution of 160km (R2B4) and an ocean resolution of 40km (R2B6) was conducted over a period of 30 years. In addition, a control run with fixed 1950 climate forcing was performed with an atmospheric resolution of 80km (R2B5) and an ocean resolution of 10km (R2B8) over a period of 10 years. These simulations were used to better understand the ICON-XPP environment and completed the step of the technical setup. The output was used to generate Figs. 1-3, also for the purpose of illustrating the strategy of the project in different presentations.

Strategy and scientific background

The sea surface temperature (SST) field as simulated with a 40km (R2B6) ocean resolution barely captures any mesoscale eddy structures (Fig. 1). Instead, the North Atlantic SST state is simulated incorrectly, i.e., a very broad and diffuse Gulf Stream and North Atlantic current with a single mid-latitude SST front is shown.

The North Atlantic SST field illustrates a very different picture when using an ocean resolution of 10km (R2B8). This enables the actual resolution of mesoscale eddies and more realistically produces a spatially more variant state with multiple mid-latitude SST fronts and a stronger meandering of the gulf stream and North Atlantic current (Fig. 2).

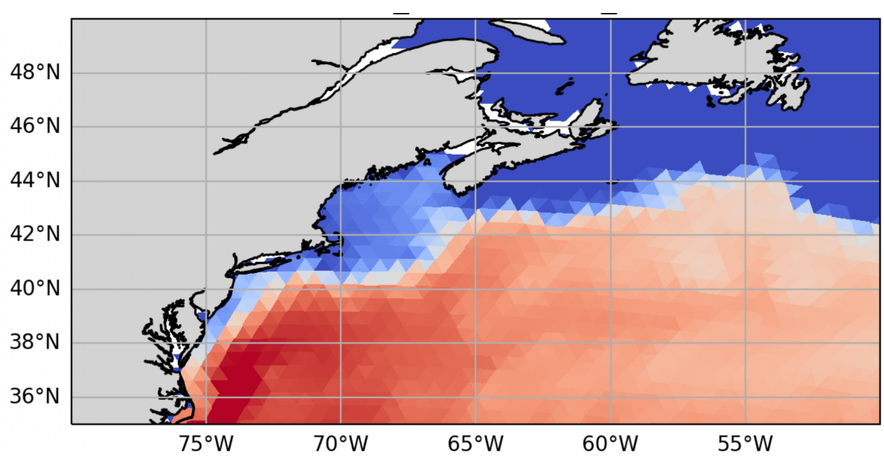

Fig. 1: Map of a snapshot of the sea surface temperature field as simulated with a ***40km (R2B6) ocean resolution.***

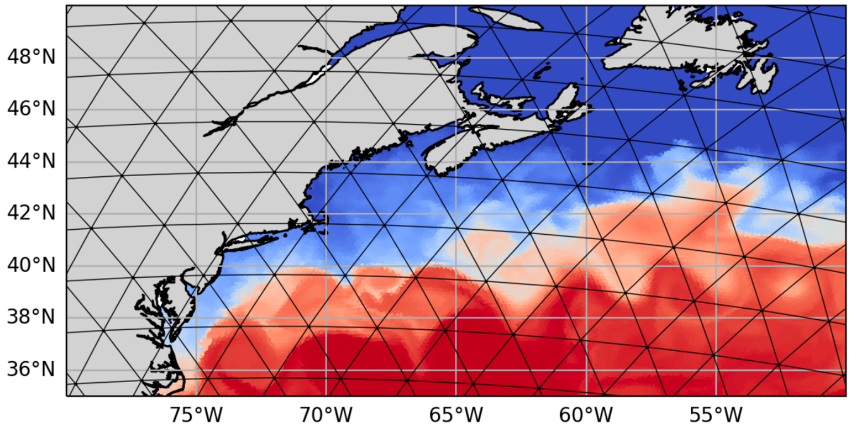

Fig. 2: Map of a snapshot of the sea surface temperature field as simulated with a ***10km (R2B8) ocean resolution****. The overlaid grid indicates the* ***160km (R2B4) atmosphere grid*** *used of the first coupled ICON-XPP experiment.*

In order to study the atmospheric response of mesoscale ocean eddies in this particular region, an atmospheric resolution is required to satisfactorily capture the eddy-related signals in the ocean. The overlaid grid of an 160km (R2B4) atmosphere would be too coarse to capture the mesoscale eddy structures.

Using a 40km atmosphere resolution would be more appropriate to capture mesoscale eddy structures and enables the analysis of the eddy-mediated feedback onto the atmospheric circulation (Fig. 3).

Current state (atmosphere-only simulations, tuning, target configuration)

In addition to the coupled ICON-XPP experiments, a historical experiment with a 80km (R2B5) atmosphere-only configuration has been done and revealed a reasonable transient climate over the simulated historical period (1979-2014). Over the same time period, we currently perform experiments with historical forcing using a 40km (R2B6) atmosphere-only configuration. After reaching a reasonable state of the transient climate (e.g., top of atmosphere radiation balance, global mean temperature), the atmosphere component will be used to be coupled to the high-resolution ocean. In this way, potentially emerging errors or huge biases can most likely not be attributed to the intrinsic atmospheric circulation.

The targeted coupled R2B6/B8 ICON-XPP simulation will be able to be compared to other configurations as further high-resolution efforts by colleagues at MPI-M are existing.

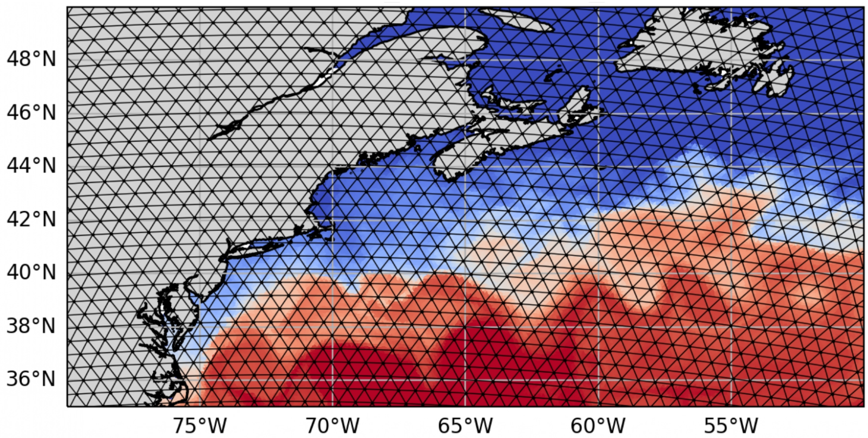

*Fig. 3: Map of a snapshot of the sea surface temperature field as simulated with a 1****0km (R2B8) ocean resolution.*** *The overlaid grid indicates the 40km (R2B6) atmosphere grid shown as target grid for the upcoming coupled ICON-XPP experiment..*